AIR FORCE

QUALIFICATION TRAINING PACKAGE (AFQTP)

for

UTILITIES SYSTEMS

(3E4X1)

MODULE 25

WATER TESTING

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MODULE 25

WATER TESTING

Career Field Education and Training Plan (CFETP) references from 1 Apr 97 version.

OPR: HQ AFCESA/CEOT

Certified by: HQ AFCESA/CEO
(Colonel Lance C. Brendel)

AIR FORCE QUALIFICATION TRAINING PACKAGES
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INTRODUCTION

Before starting this AFQTP, refer to and read the "Trainee/Trainer Guide" located on the AFCESA Web site **http://www.afcesa.af.mil/**

AFQTPs are mandatory and must be completed to fulfill task knowledge requirements on core and diamond tasks for upgrade training. ***It is important for the trainer and trainee to understand*** that an AFQTP ***does not*** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.

MANDATORY minimum upgrade requirements:

Core task:
AFQTP completion
Hands-on certification

Diamond task:
AFQTP completion
CerTest completion (80% minimum to pass)

Note: *Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location.*

Put this package to use. Subject matter experts under the direction and guidance of HQ AFCESA/CEOT revised this AFQTP. If you have any recommendations for improving this document, please contact the Field Manager at the address below.

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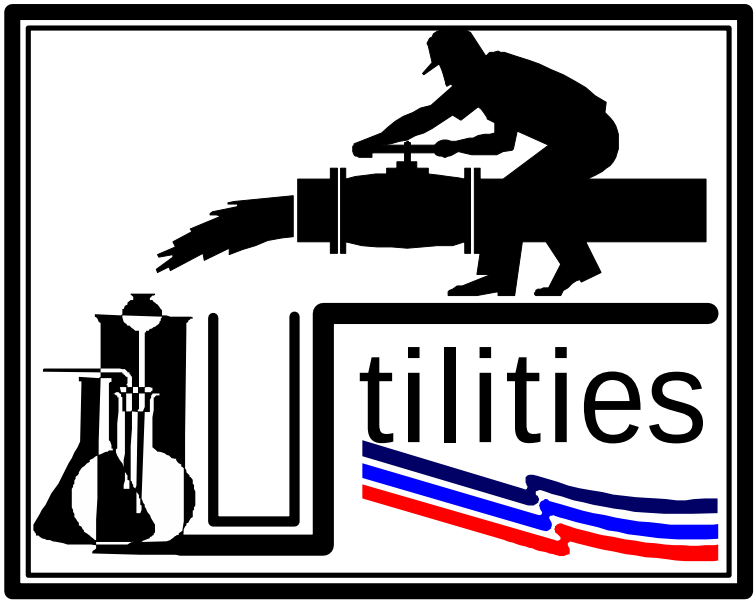


WATER TESTING

MODULE 25 AFQTP UNIT 1

SAMPLE COLLECTION PROCEDURES (25.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

SAMPLE COLLECTION PROCEDURES

Task Training Guide

STS Reference Number/Title:	25.1., Sample Collection Procedures
Training References:	• CDC 3E451B Vol. 3 • Study Guide/Workbook J3ABR3E451
Prerequisites:	• Possess as a minimum a 3E431 AFSC.
Equipment/Tools Required:	• Sampling Container
Learning Objective:	• Trainee will collect samples
Samples of Behavior:	• Trainee will understand the steps to collect samples
Notes:	

SAMPLE COLLECTION PROCEDURES

Background: There are many reasons to collect numerous samples. But, how you collect a sample can dictate what your results will be. The three important factors when collecting samples are where, when, why. Annotate where the sample was collected and why the sample was collected. The time the sample was collected is very crucial as well. If taking a sample during peak usage in a pool, hydrant, tap, waste plant or water plant, the results of the samples will differ if taken at a low usage period.

There are methods of collecting samples: (1) A grab sample is a single sample of wastewater that is collected from a sampling point to show the "real time" conditions. (2) Composite samples are collections from a sampling point and a representation of what has transpired over a period of time. The details and care in collecting samples cannot be over-emphasized.

The label used on the sample should have the following information:

- **Name of the person collecting the sample**
- **Date sample was obtained**
- **Temperature of the sample**
- **Where the sample was collected (Source)**
- **Type of analysis to be performed**

SAMPLE COLLECTION.

To perform this task, follow these steps:

Step 1: Gather required equipment.

NOTE:
Collect samples in containers free from any contaminants. If the sample container or stopper is contaminated, rinse the container free of contaminants or replace it with a sanitized container.

Step 2: Remove the stopper or lid used to protect sample jar or tube.

Step 3: Rinse the container with the water to be tested.

- **Wells**-Pump the water in the well until normal usage peak occurs.
- **Surface supplies**-Take samples from the deepest and best flow of the stream or lake.
- **Treatment Plant**-Take water samples from channels, pipe taps where water is well **mixed.**
- **Tap or Distribution System**-Allow the water to run for to flush the line for 3-5 minutes; then collect sample.

HINT:
It is best if you fill and rinse the sample container three times before collecting the sample; however, if a bacteriological, dissolved oxygen, etc. is performed, do not rinse.

These sample bottles are pre-prepared or pre-sanitized and rinsing will remove the sodium thiosulfate or other neutralizing agents.

Step 4: Common Procedure for Pools or Lakes.

- Plunge the container into the water, holding the mouth down and keeping it at about a 45-degree angle at least 3 inches beneath the surface.
- Tilt the container up and allow air to escape as the bottle fills, all the while moving it in a direction away from your hand so that water that has touched your hand does not enter the container.
- Then, discard a quarter of the water.

Step 5: Replace stopper or lid.

Step 6: Annotate the time, place, and reason for sample.

Step 7: Take sample to be tested or stored.

HINT:
Caution must be taken to keep the rim and interior of the container free of contamination during the time of collecting the sample.

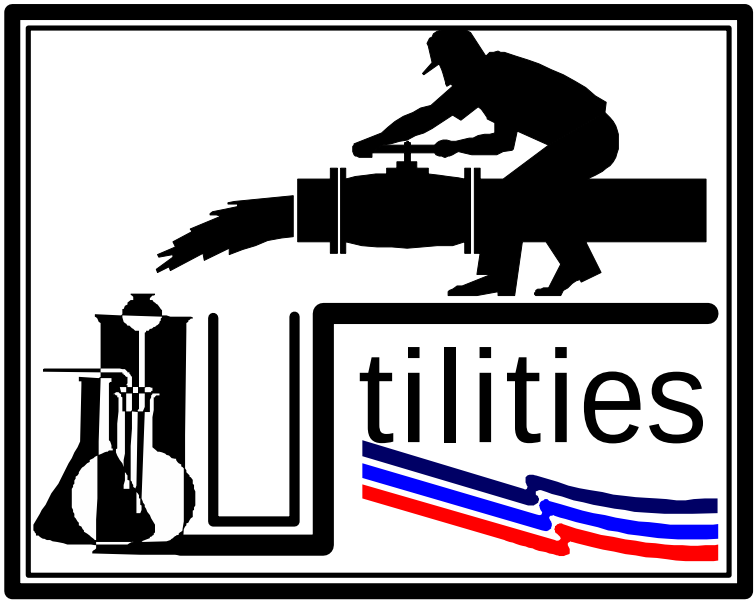
Review Questions
for
Sample Collection Procedures

Question	Answer
1. What factors are considered when collecting samples?	a. Why and when b. Why and What c. When and where d. Why, when and where
2. What are the two methods of collecting samples?	a. Rinse and Grab b. Reach and Rinse c. Grab and Composite d. Composite and Rinse
3. Depending on the reason for a sample being collected, the procedures may vary.	a. True b. False
4. It does not matter if your sample container becomes contaminated.	a. True b. False

SAMPLE COLLECTION PROCEDURES

Performance Checklist		
Step	**Yes**	**No**
1. Did the trainee identify all the equipment needed for the job?		
2. Did the trainee take proper safety precautions?		
3. Did the trainee properly collect samples following the QTP? • Gather required equipment. • Remove the stopper or lid used to protect sample jar or tube. • Rinse the container with the water to be tested. • Replace stopper or lid. • Annotate the date, place, temperature of sample, and reason sample was collected. • Take sample to be tested or stored**.**		
4. Does the trainee understand how to collect samples?		
5. Did the trainee complete the questions in the QTP? • Score 80% or higher. • Did trainer review and explain all missed questions?		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.



PERFORM WATER TESTS

MODULE 25 AFQTP UNIT 2

PH (25.2.1.)

PH

Task Training Guide

STS Reference Number/Title:	25.2.1., pH
Training References:	• AFJMAN 32-1070 • TOs 40W4-13-41 • CDC 3E451
Prerequisites:	• Possess as a minimum a 3E431 AFSC
Equipment/Tools Required:	• Color Comparator with Indicator Tablets
Learning Objective:	• The trainee will know the steps required to perform a pH test on a water source.
Samples of Behavior:	• Trainee will know the required steps to perform pH test.
Notes:	
• To successfully complete this element, the steps must be followed exactly--no exceptions • Any safety violation is an automatic failure	

PH

Background: The relative strength of an acid or base is expressed in terms of pH. This is a unit measure of the number of free hydrogen ions (H^+) in a solution as compared to pure water. The pH scale has a range of 0 to 14.

- A pH reading of 6.9 and below indicates the sample is more acidic.
- If there are equal amounts of H^+ and OH ions in a solution this would indicate a neutral sample or a pH reading of 7.0.
- A pH reading of 7.01 - 14 would show that the sample was more alkaline.

STEPS FOR TESTING PH.

To perform this task, follow these steps:

Step 1: Get the test kit

- Having the proper equipment (in working order) will save valuable time and avoid round-trips to the shop. Not being prepared will cause unnecessary delays and ultimately higher labor costs.

Step : Check the color comparator.

- Ensure the appropriate disk is installed to test for pH.

NOTE:
Different color disks are used for testing pH and chlorine residual.

Step 3: Check sample tubes. Ensure the unit has two glass sample tubes.

Step 4: Rinse sample tubes.

- Rinse both tubes and their caps three times with water to be tested.

Step 5: Collect sample.

- Fill both tubes to appropriate fill line (5 ml) with sample water.

Step 6: Position blank in the color comparator.

- Place the tube of untreated water sample in the left top opening of the color comparator, this is known as the blank sample. (See Figure 1).

Step 7: Add indicator.

- Using your index finger Push out the phenol red tablet from the foil and allow it to fall into the tube. Install the cap and swirl tube for 10 seconds to mix contents.(See Figure 2).

NOTE:
Touching tablet with fingers or not using cap may cause inaccurate reading.

Step 8: Position sample in the color comparator.

- Insert tube of treated water sample in the right top opening of the comparator, give it a few seconds for the chemical to react. (See Figure 3).

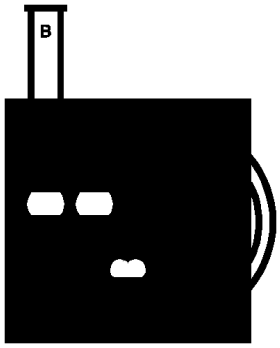


Figure 1, Placing the Blank

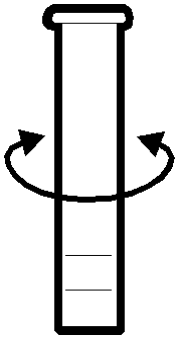


Figure 2, Swirling the Sample

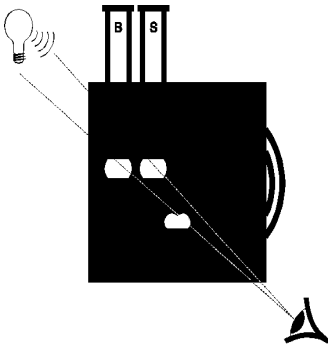


Figure 3, Comparing the Blank and the Sample

"Reprinted with permission from Hach Company, Loveland, Colorado USA"

Step 9: Compare the blank and the sample.

- Elevate the color comparator to eye level up to a light such as the sky, window, or lamp, rotating disk until the closest match is achieved. (See Figure 3).

Step 10: Take reading.

- Obtain reading through scale window.

NOTE:
It is important that results are read within one minute after mixing samples.

Step 11: Record reading.

- Write down reading in mg/l or ppm.

Step 12: Clean up.

- Discard sample and rinse tubes with water.

SAFETY:
THE CHEMICALS IN THE KIT MAY BE HAZARDOUS TO THE HEALTH AND SAFETY OF THE USER IF INAPPROPRIATELY HANDLED. PLEASE READ ALL WARNINGS BEFORE PERFORMING THE TEST AND USE APPROPRIATE SAFETY EQUIPMENT.

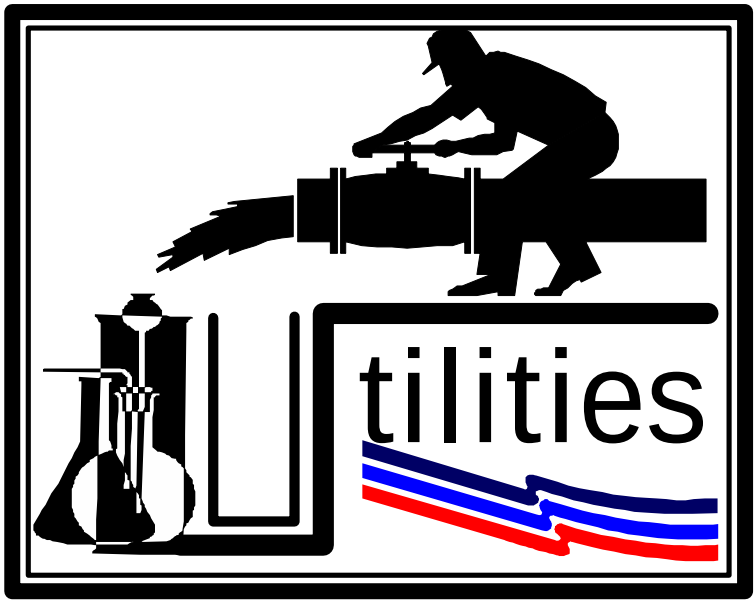
Review Questions for PH

Question	Answer
1. A reading in what pH range would indicate that the sample is acidic?	a. 0 -6.9 b. 7.0 c. 7.01 - 14 d. All of the above
2. You may use your fingers to place the indicator tablet into the sample tube.	a. True b. False
3. What is the pH reading for neutral?	a. 7.01 b. 8 c. 6.9 d. 7.0
4. The relative strength of an acid or base is expressed in terms of pH.	a. True b. False
5. pH has a scale range of _____.	a. 0 - 6.9 b. 0 – 50. c. 7.0 – 14 d. 0 - 14
6. What is the chemical name of the indicator tablet used to test the pH of the sample?	a. DpD b. Cresol red c. Phenol red d. Litmus paper

PH

Performance Checklist		
Step	**Yes**	**No**
1. Did the trainee identify all the equipment needed for the job?		
2. Did the trainee take proper safety precautions?		
3. Did the trainee perform the test following the steps in the QTP? • Get the test kit • Check the color comparator • Check sample tubes • Collect sample. • Position blank in the color comparator • Add indicator • Position sample in the color comparator • Compare the blank and the sample. • Take reading • Record reading • Clean up		
4. Did the trainee complete the questions in the QTP? • Score 80% or higher. • Did trainer review and explain all missed questions?		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.



PERFORM WATER TESTS

MODULE 25 AFQTP UNIT 2

CHLORINE RESIDUAL (25.2.2.)

CHLORINE RESIDUAL

Task Training Guide

STS Reference Number/Title:	25.2.2., Chlorine residual
Training References:	• AFJMAN 32-1079 • TOs 40W4-13-41 • CDC 3E451
Prerequisites:	• Possess as a minimum a 3E431 AFSC
Equipment/Tools Required:	• Color Comparator with Free available chlorine packets.
Learning Objective:	• The trainee will know the steps required to accurately perform Chlorine Residual test on a given water source.
Samples of Behavior:	• Trainee will be able to name the equipment required to perform Chlorine Residual test. • Trainee will know required steps to perform Chlorine Residual test.
Notes:	
• To successfully complete this element, the steps must be followed exactly--no exceptions • Any safety violation is an automatic failure	

CHLORINE RESIDUAL

Background: Chlorine (Cl_2) is added to a drinking water supply, waste water treatment plant effluent, and swimming pools to kill bacteria that is harmful to humans. Chlorine also removes odors in water. **Residual** Cl_2 is the amount of chlorine remaining in the water of a distribution system after the Cl_2 **demand** (impurities in the sample) is contacted.

STEPS TO CL_2 TESTING.

To perform this task, follow these steps:

Step 1: Gather required equipment.

- The first step of a task is often the one that could cause or cure unnecessary problems down the line. Having the proper equipment (in working order) will save valuable time and avoid round-trips to the shop. Not being prepared will cause unnecessary delays and ultimately higher labor costs.

Step 2: Check the color comparator.

- Check color comparator to ensure Cl_2 disk is installed.

NOTE:
Different color disk is used for testing pH and chlorine residual.

Step 3: Check sample tubes.

- Ensure the unit has two glass sample tubes.

Step 4: Rinse sample tubes.

- Rinse both tubes and their caps twice with water to be tested.

Step 5: Collect sample.

- Fill both tubes to appropriate fill line (5 ml) with sample water.

Step 6: Position blank in the color comparator.

- Place the tube of untreated water sample in the left top opening of the color comparator, this is known as the blank sample. (See Figure 1).

Step 7: Add indicator.

- Use your index finger to punch out the N N-diethyl-p-phenylenediamine (DPD) tablet from the foil and allow it to fall into the tube.
- Avoid direct contact with your hands and the indicator.
- Cap the sample tube and swirl for 10 seconds to mix contents. (See Figure 2).

NOTE:
Never use your fingers as a replacement for the cap, doing so may cause an inaccurate reading.

Step 8: Position sample in the color comparator.

- Insert tube of treated water sample in the right top opening of the color comparator, give it three minutes for the chemical to react.

NOTE:
All the tablet or powder does not have to dissolve to get a correct reading.

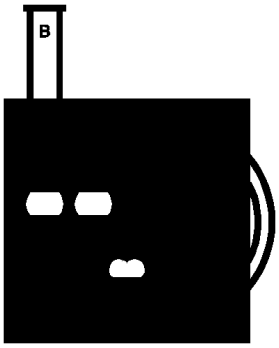


Figure 1, Placing the Blank

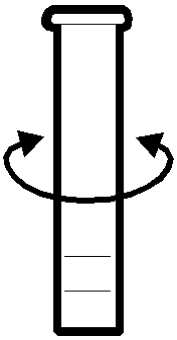


Figure 2, Swirling the Sample

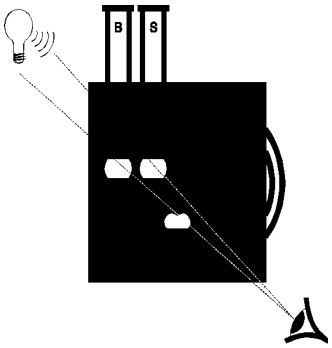


Figure 3, Comparing the Blank and the Sample

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Step 9: Compare the blank and the sample.

- Elevate the color comparator to eye level up to a light such as the sky, window, or lamp, rotating disk until the closest match is achieved. (See Figure 3).

Step 10: Take reading.

- Obtain reading through scale window.

NOTE:
It is important that results are read within one minute after mixing samples.

Step 11: Record reading.

- Write down reading in mg/l or ppm.

Step 12: Clean up.

- Discard sample and rinse tubes with water..

SAFETY:
THE CHEMICALS IN THE KIT MAY BE HAZARDOUS TO YOUR HEALTH AND SAFETY OF THE USER IF INAPPROPRIATELY HANDLED. PLEASE READ ALL WARNINGS BEFORE PERFORMING THE TESTS AND USE APPROPRIATE SAFETY EQUIPMENT.

Review Questions
for
Chlorine Residual

Question	Answer
1. What is used to kill bacteria in drinking water supply?	a. Phenol red b. DPD c. Chlorine d. Cresol red
2. The amount of chlorine remaining in the water of a distribution system following chlorination is called?	a. Total chlorine b. Chlorine demand c. Chlorine pH level d. Residual chlorine
3. How many sample tubes are required to perform a chlorine residual test?	a. 1 b. 2 c. 3 d. 4
4. When are you allowed to place your finger over sample tube opening?	a. Never b. When cap is missing c. When devolving indicator tablet d. When supervisor instructs you to do so
5. What is the chemical name of indicator tablet?	a. Phenol red b. Potassium chloride c. N N-diethyl-p-phenylenediamine d. DPP

CHLORINE RESIDUAL WATER TESTING

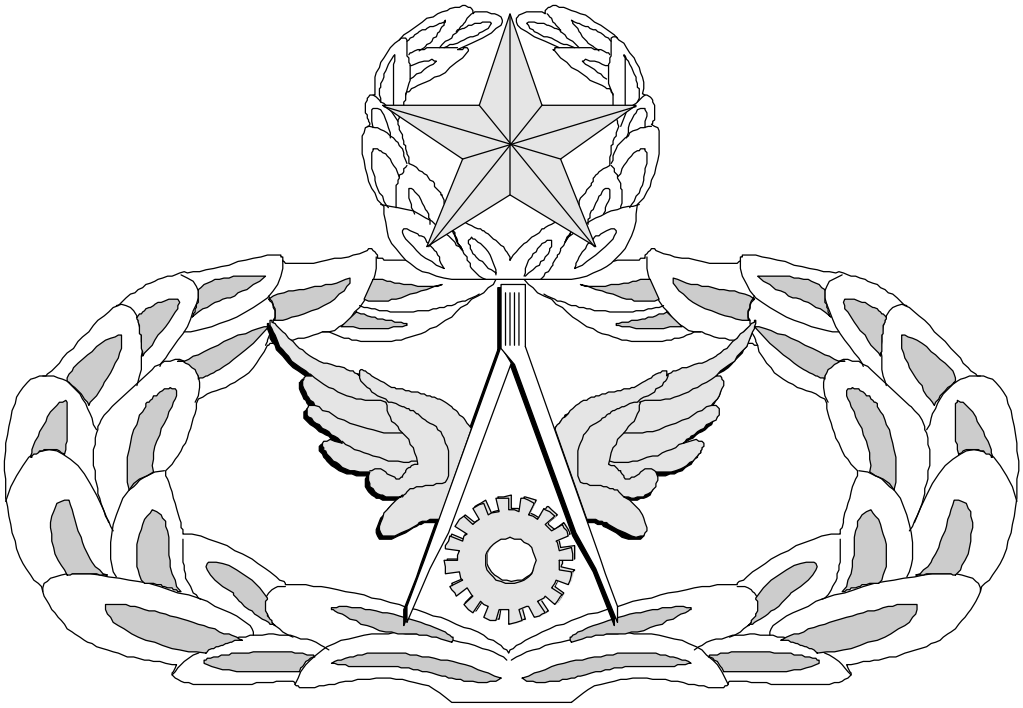
Performance Checklist		
Step	**Yes**	**No**
1. Did trainee identify all the equipment needed for the job?		
2. Did the trainee take proper safety precautions?		
3. Did the trainee perform the test following the steps in the QTP? • Gather required equipment • Check the color comparator • Check sample tubes • Collect sample Rinse sample tubes • Position blank in the color comparator • Add indicator • Position sample in the color comparator • Compare the blank and the sample • Take reading • Record reading • Clean up		
4. Did the trainee complete the questions in the QTP? • Score 80% or higher. • Did trainer review and explain all missed questions?		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

Air Force Civil Engineer

QUALIFICATION TRAINING PACKAGE (QTP)

REVIEW ANSWER KEY



For

UTILITIES SYSTEMS

(3E4X1)

MODULE 25

WATER TESTING

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

SAMPLE COLLECTION PROCEDURES

(3E4X1-25.1.)

Question	Answer
1. What factors are considered when collecting samples?	d. Why, when and where
2. What is the two method of collecting samples?	c. Grab and Composite
3. Depending on the reason for a sample being collected, the procedures may vary.	a. True
4. It does not matter if your container becomes contaminated.	b. False

PH

(3E4X1-25.2.1.)

Question	Answer
1. A reading in what pH range would indicate that the sample is acidic?	a. 0 -6.9
2. You may use your fingers to place the indicator tablet into the sample tube.	b. False
3. What is the pH reading for neutral?	d. 7.0
4. The relative strength of an acid or base is expressed in terms of pH.	a. True
5. pH has a scale range of _____.	d. 0 - 14
6. What is the chemical name of the indicator tablet used to test the pH of the sample?	c. Phenol red

CHLORINE RESIDUAL

(3E4X1-25.2.2.)

Question	Answer
1. What is used to kill bacteria in drinking water supply?	c. Chlorine
2. The amount of chlorine remaining in the water of a distribution system following chlorination is called?	d. Residual chlorine
3. How many sample tubes are required to perform a chlorine residual test?	b. 2
4. When are you allowed to place your finger over sample tube opening?	a. Never
5. What is the chemical name of indicator tablet?	c. N N-diethyl-p-phenylenediamine